CLAIMS

1. A method of hydrogenating an unsaturated feedstock, comprising:
   producing a catalyst composition by heating a nickel-based catalyst to a first temperature of at least about 100° C in the presence of a process gas and a fat component; and, thereafter,
   contacting the unsaturated feedstock with the catalyst composition and hydrogenating the unsaturated feedstock by sustaining a hydrogenation reaction at a second temperature of no greater than about 70° C, the feedstock comprising at least one unsaturated organic component.

2. The method of claim 1 wherein the process gas comprises hydrogen.

3. The method of claim 1 wherein the process gas comprises nitrogen.

4. The method of claim 1 wherein the second temperature is no greater than about 60° C.

5. The method of claim 1 wherein the second temperature is no greater than about 50° C.

6. The method of claim 1 wherein the second temperature is about 0-60° C.

7. The method of claim 1 wherein the second temperature is about 20-50° C

8. The method of claim 1 wherein the second temperature changes over the course of the hydrogenation reaction, the hydrogenation reaction being initiated at a second temperature no greater than about 50° C.

9. The method of claim 1 wherein the second temperature changes over the course of the hydrogenation reaction, the hydrogenation reaction being

initiated at a second temperature no greater than about 50° C, the hydrogenation reaction being completed without exceeding about 70° C.

10. The method of claim 1 wherein the hydrogenation reaction at the second temperature changes an Iodine Value of the feedstock, the Iodine Value changing at an average rate of no less than about 5/hour.

11. The method of claim 1 wherein the hydrogenation reaction at the second temperature changes an Iodine Value of the feedstock, the Iodine Value changing at an average rate of about 6-40/hour.

12. The method of claim 1 wherein hydrogenating the unsaturated feedstock includes delivering a hydrogenation gas to the feedstock, the hydrogenation gas consisting essentially of hydrogen.

13. The method of claim 1 wherein the nickel-based catalyst composition has a total nickel content of about 2-35 weight percent.

14. The method of claim 1 wherein the nickel-based catalyst composition has a total nickel content of about 2-35 weight percent, and nickel comprises no more than about 1 weight percent of the combined unsaturated feedstock and catalyst composition.

15. The method of claim 1 wherein the nickel-based catalyst is dispersed in the fat component, the fat component being a solid at room temperature and liquid at the first temperature.

16. The method of claim 1 wherein contacting the unsaturated feedstock with the catalyst composition comprises dispersing the nickel-based catalyst in the unsaturated feedstock.

17. The method of claim 1 wherein the feedstock comprises an oil and the at least one unsaturated organic component comprises a polyunsaturated fatty acid.

18. The method of claim 1 wherein the at least one unsaturated organic component comprises an unsaturated hydrocarbon.

19. The method of claim 1 wherein a fat matrix of the catalyst composition has a melting point that is higher than the second temperature.

20. The method of claim 1 wherein a fat matrix of the catalyst composition has a melting point that is no higher than the second temperature.

21. The method of claim 1 wherein producing the catalyst composition includes hydrogenating the fat component, the catalyst composition comprising an activated catalyst dispersed in a hydrogenated fat matrix.

22. The method of claim 21 wherein the hydrogenated fat matrix has a melting point that is higher than the second temperature.

23. The method of claim 1 wherein a fat matrix of the catalyst composition has a melting point that is higher than the second temperature, and wherein the catalyst composition is at a temperature at least as high as the melting point when added to the feedstock.

24. The method of claim 1 further comprising introducing hydrogen into the feedstock before adding the catalyst composition.

25. The method of claim 1 wherein the catalyst composition is substantially the only catalyst source during the hydrogenation of the feedstock.

26. The method of claim 1 wherein hydrogenating the unsaturated feedstock produces a hydrogenated feedstock, further comprising cooling the

hydrogenated feedstock from the second temperature to a third temperature under a hydrogen atmosphere.

27. The method of claim 1 wherein hydrogenating the unsaturated feedstock produces a hydrogenated feedstock, further comprising cooling the hydrogenated feedstock from the second temperature to a third temperature of no greater than about 35° C under a hydrogen atmosphere.

28. A method of hydrogenating an unsaturated oil having an initial Iodine Value and an initial fatty acid content including at least about 4 weight percent C18:3, the method comprising:
dispersing a nickel-based catalyst in the oil;
delivering hydrogen to the oil; and
hydrogenating the oil at a hydrogenation temperature no greater than about 70° C for a hydrogenation time to yield a hydrogenated oil having a modified Iodine Value and including a modified fatty acid content, wherein the hydrogenated oil is at least semi-liquid at 25° C, an absolute difference between the initial Iodine Value and the modified Iodine Value divided by the hydrogenation time defines an average Iodine Value change rate of no less than about 5/hour, no more than about 2.5% of the modified fatty acid content comprises C18:3, and no more than about 6% of the modified fatty acid content comprises *trans*-fatty acids.

29. The method of claim 28 wherein the oil is at the hydrogenation temperature when initiating the hydrogenation and the oil is hydrogenated without adding external heat.

30. The method of claim 28 wherein hydrogen is delivered to the oil before dispersing the nickel-based catalyst in the oil.

31. The method of claim 28 wherein the nickel-based catalyst is included in a catalyst composition that also comprises a fat matrix.

32. The method of claim 31 wherein dispersing the nickel-based catalyst comprises melting the fat matrix.

33. The method of claim 31 wherein the fat matrix has a melting point that is higher than the hydrogenation temperature.

34. The method of claim 28 wherein nickel comprises no more than about 1 weight percent of the combined oil and nickel-based catalyst.

35. The method of claim 28 wherein the hydrogenation temperature is no greater than about 50° C.

36. The method of claim 28 wherein the hydrogenation temperature is about 20-50° C.

37. The method of claim 28 wherein the hydrogenation temperature changes over the course of the hydrogenation time, the hydrogenation reaction being initiated at a hydrogenation temperature no greater than about 50° C.

38. The method of claim 28 wherein the hydrogenation temperature changes over the course of the hydrogenation time, the hydrogenation reaction being initiated at a hydrogenation temperature no greater than about 50° C and the hydrogenation temperature not exceeding about 70° C during the hydrogenation time.

39. The method of claim 28 wherein the average Iodine Value change rate is between about 6/hour and about 30/hour.

40. The method of claim 28 wherein delivering hydrogen to the oil comprises delivering a gas consisting essentially of hydrogen.

41. The method of claim 28 wherein the nickel-based catalyst is substantially the only catalyst source during the hydrogenation of the oil.

42. The method of claim 28 further comprising cooling the hydrogenated oil from the hydrogenation temperature under a hydrogen atmosphere.

43. The method of claim 28 further comprising cooling the partially hydrogenated feedstock from the second temperature to a third temperature of no greater than about 35° C under a hydrogen atmosphere.

44. A method of hydrogenating an oil having an initial Iodine Value and an initial induction period, the method comprising:
dispersing a nickel-based catalyst in the oil;
delivering hydrogen to the oil; and
hydrogenating the oil at a hydrogenation temperature no greater than about 70° C for a hydrogenation time to yield a hydrogenated oil having a modified Iodine Value and a modified induction period, wherein an absolute difference between the initial Iodine Value and the modified Iodine Value divided by the hydrogenation time defines an average Iodine Value change rate of no less than about 5/hour, and the modified induction period is at least twice the initial induction period.

45. The method of claim 44 wherein the initial induction period and the modified induction period are measured at about 120° C.

46. The method of claim 44 wherein no more than about 6 weight percent of a total fatty acid content of the hydrogenated oil is *trans*-fatty acid.

47. The method of claim 44 wherein the hydrogenation temperature is about 20-50°C.

48. The method of claim 44 wherein nickel comprises no more than about 1 weight percent of the combined oil and nickel-based catalyst.

49. A substantially platinum-free hydrogenation catalyst composition comprising:
a solid hydrogenated fat matrix; and
a nickel-based catalyst dispersed in the hydrogenated fat matrix, the nickel-based catalyst being adapted to sustain, at a temperature of about 70° C or less and in the presence of hydrogen, a hydrogenation reaction of a dielectric oil comprising polyunsaturated fatty acids.

50. The hydrogen catalyst composition of claim 49 wherein the catalyst composition has a total nickel content of about 2-35 weight percent.

51. The hydrogen catalyst composition of claim 49 wherein the catalyst composition has a total nickel content of about 2-35 weight percent, the catalyst being adapted to sustain the hydrogenation reaction at the temperature when the nickel comprises no more than about 1 weight percent of the combined oil, nickel-based catalyst, and fat matrix.

52. The hydrogen catalyst composition of claim 49 wherein the temperature is no greater than 50° C.

53. A method of hydrogenating an edible oil having an initial Iodine Value and an initial fatty acid content that includes at least about 4 weight percent C18:3, the method comprising:
providing a catalyst composition including a fat component and a nickel-based catalyst that has been activated by heating to a first temperature in the presence of hydrogen;
dispersing the catalyst composition in the oil;
delivering hydrogen to the oil; and

hydrogenating the oil at a second temperature to yield a hydrogenated oil having a modified Iodine Value and including a modified fatty acid content, wherein:

the second temperature is less than the first temperature;

the hydrogenated oil is at least semi-liquid at 25° C;

an absolute difference between the initial Iodine Value and the modified Iodine Value divided by the hydrogenation time defines an average Iodine Value change rate of about 6-40/hour;

no more than about 2 weight percent of the modified fatty acid content comprises C18:3; and

no more than about 5 weight percent of the modified fatty acid content comprises *trans*-fatty acids.

54. The method of claim 53 wherein dispersing the catalyst composition comprises contacting the catalyst composition, which is at a third temperature, with the oil, the third temperature being greater than the second temperature and at least as great as a melting point of the fat composition.

55. The method of claim 54 wherein the third temperature is no greater than the first temperature.

56. The method of claim 54 wherein the edible oil has an initial induction period and the hydrogenated oil has an induction period that is at least twice the initial induction period.

57. An edible hydrogenated fat composition formed by the process of claim 1.

58. The edible hydrogenated fat composition of claim 57 wherein the feedstock comprises an edible oil selected from a group consisting of seed oils, vegetable oils, marine oils, and blends of two or more of seed oil, vegetable oil, and marine oil.

59. An edible hydrogenated fat composition formed by the process of claim 28.

60. The edible hydrogenated fat composition of claim 59 wherein the feedstock comprises an edible oil selected from a group consisting of seed oils, vegetable oils, marine oils, and blends of two or more of seed oil, vegetable oil, and marine oil.

61. An edible hydrogenated fat composition formed by the process of claim 44.

62. An edible hydrogenated fat composition formed by the process of claim 53.

63. A partially hydrogenated edible oil comprising an oil selected from a group consisting of soybean oil and canola oil, wherein the partially hydrogenated edible oil:
is semi-liquid at about 25°C;
has a C18:3 content of no greater than about 2.5 weight percent;
has a *trans*-fatty acid content of no more than about 6 weight percent; and
has a ratio of C18 content to the *trans*-fatty acid content (C18 : TFA) of at least about 1.2.

64. The partially hydrogenated edible oil of claim 63 wherein the oil comprises soybean oil.

65. The partially hydrogenated edible oil of claim 63 wherein the oil comprises canola oil.

66. The partially hydrogenated edible oil of claim 63 wherein the C18 : TFA ratio is at least about 1.5.

67. The partially hydrogenated edible oil of claim 63 wherein the C18 : TFA ratio is at least about 2.

68. The partially hydrogenated edible oil of claim 63 wherein a ratio *cis*- to *trans*-forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) is at least about 6.

69. The partially hydrogenated edible oil of claim 63 wherein a ratio *cis*- to *trans*-forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) is at least about 12.

70. A partially hydrogenated edible oil comprising an oil selected from a group consisting of soybean oil and canola oil, wherein the partially hydrogenated edible oil:
is semi-liquid at about 25°C;
has a C18:3 content of no greater than about 2.5 weight percent;
has a *trans*-fatty acid content of no more than about 6 weight percent; and
has a ratio of *cis*- to *trans*- forms of C18:1, C18:2 and C18:3 fatty acids (CFA : TFA) of at least about 6.

71. The partially hydrogenated edible oil of claim 70 wherein the CFA : TFA ratio is at least about 9.

72. The partially hydrogenated edible oil of claim 70 wherein the CFA : TFA ratio is at least about 12.

73. The partially hydrogenated edible oil of claim 70 wherein a ratio of C18 content to the *trans*-fatty acid content (C18 : TFA) is at least about 1.5.

74. The partially hydrogenated edible oil of claim 70 wherein a ratio of C18 content to the *trans*-fatty acid content (C18 : TFA) is at least about 2.